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Evaluation Comparing Multiple Treatments With a 2-msec and 10-msec Alexandrite Laser for Hair Removal

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Background and Objectives: **There are a variety of different laser hair removal systems currently available. There are also systems with identical emitted wavelengths; yet their emitted pulse durations vary. There are few data comparing these systems in an objective manner.**
Study Design/Materials and Methods: **Fourteen subjects received three treatments with two different pulse duration 755-nm alexandrite lasers. Paired anatomic sites were treated three times with both a 2-msec and a 10-msec system. Subjects were evaluated prior to laser treatment and 6 months after the three treatments with manual hair counts and incidence of complications.**
Results: **The average percentage of hair reduction was 33.1% for the 2-msec-pulse duration and 33.9% for the 10-msec-pulse duration alexandrite laser. No cutaneous pigmentary changes or scarring was noted 6 months after the final treatment.**
Conclusion: **The alexandrite laser is effective in removing unwanted hair. There was no difference in response between a 2-msec and a 10-msec alexandrite laser. Lasers Surg. Med. 25:223–228, 1999.** **© 1999 Wiley-Liss, Inc.**

Key words: laser hair removal; alexandrite laser; multiple treatments; pulse duration

INTRODUCTION

Excessive hair growth in unwanted areas is a frequently encountered problem, with possible severe psychosocial consequences to affected individuals. Increased body hair may be due to a variety of causes, including endocrine disorders, inherited syndromes, and medications, or they may be idiopathic in nature [1]. For many people, removing unwanted hair is a daily ritual. Common temporary methods include shaving, tweezing, hot wax epilation, bleaching, chemical depilatories, and makeup [2]. These methods are not only temporary, but may induce such problems as irritation or folliculitis.

Electrolysis is a well-established method that has been shown to permanently remove hair [3]. The problem with this procedure is that it can be very painful, can potentially causes scars, and is very time-consuming.

Laser-assisted hair removal has recently received attention because of its ability to noninvasively remove large areas of unwanted hair with minimal discomfort and a low incidence of complications [4]. There are currently multiple lasers and laser-like light sources that can safely remove hair based on Anderson and Parrish's 1981 principle of selective photothermolysis [5].

Under the principle of selective photothermolysis, when a pigmented target absorbs a particular wavelength of light in an amount of time that is shorter than or equal to the thermal relaxation time of the targeted structure, the targeted tissue will be selectively destroyed without surrounding tissue injury. The endogenous chromophore of hair follicles is melanin, which is found in the follicular germinal cells in the hair shaft and bulb [5–7]. Recent studies have demonstrated that laser and light source treatment may also impact another region, the bulge [6–8]. In order to

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damage these follicular structures, the wavelength of light should be in the red and near-infrared range of electromagnetic radiation (600–1,100 nm) [9].

Anecdotal experience has suggested that greater hair follicle injury can be achieved by increasing the exposure time (or pulse duration) of the laser. The thermal relaxation time (TRT) of hair follicles with a diameter of 200–300 μm is approximately 40–l00 msec [10]. The TRT of the epidermis is approximately 3 msec. The optimal pulse duration would theoretically be between the TRT of the hair follicle and the epidermis. This study analyzed this concept by comparing laser hair removal efficacy with a 2-msec vs. 10-msec pulsed 755-nm alexandrite laser.

MATERIALS AND METHODS

Fourteen healthy adult volunteers (three male, 11 female, age range 19–51 years) were enrolled in an Institutional Review Board (IRB)-approved study. Treatment sites included the chin, neck, back, bikini, and lower leg; treated subjects included Fitzpatrick skin phototypes I–III. All subjects had black or brown terminal hairs. Exclusion criteria included a history of photosensitivity, concurrent pregnancy, oral retinoid use within 12 months of the study, and recently tanned skin. Prior to treatment, baseline photographs of anatomical sites were taken.

A pulsed alexandrite laser (ESC-Sharplan, Needham, MA) with a wavelength of 755 nm, pulse duration of 2 msec, energy fluence of 25 J/cm^2, 7-mm spot size, and a repetition rate of 5 pulses per sec was compared with a pulsed alexandrite laser (ESC-Sharplan) with a pulse duration of 10 msec, energy fluence of 25 J/cm^2, 7-mm spot size, and a repetition rate of three pulses per second. After photographs were taken, skin sites were shaved, and a transparent, cooled, water-

Fig. 1. **a:** Chin before treatment with 2-msec alexandrite laser. **b:** Chin before treatment with 10-msec alexandrite laser.

Fig. 2. **a:** Chin 6 months after third treatment with 2-msec alexandrite laser. **b:** Chin 6 months after third treatment with 10-msec alexandrite laser.

based gel was applied to a delineated site. A transparent template with 7-mm spacing alignment dots was placed on the gel; the laser was then fired at the skin. Paired anatomic sites were treated. Treatment was completed when all dots were removed from the template. At the end of treatment, bacitracin ointment was applied to the skin. Consecutive treatment and evaluations occurred at 2–3-month intervals for a total of three treatment visits. Subjects were examined for complications such as erythema, pigmentary changes, and scars. Photographs were taken before the initial treatment and 6 months following the third and final treatment. Two-millisecond and 10-msec laser treatment results were compared side by side for a given anatomical site. Manual terminal hair counts were performed at baseline and compared with similar evaluations at the end of the study. The percentage of hair loss was defined as the number of terminal hairs present after treatment compared with the number of terminal hairs present at baseline.

RESULTS

Immediate posttreatment perifollicular edema and/or erythema was noted in all treated subjects. Occasional subjects were noted to have some crusting at the treated sites. This was more prevalent in areas of greater hair density such as the legs. No posttreatment blistering was noted. The average percentage of hair reduction was 33.1% for the 2-msec pulse duration and 33.9% for the l0-msec pulse duration alexandrite laser (Figs. 1–6). There was a slightly greater, albeit statistically insignificant, hair loss of thicker hairs (such as those seen on the backs of men) with the 10-msec alexandrite laser. The most common posttreatment complication was perifollicular erythema. This developed immediately af-

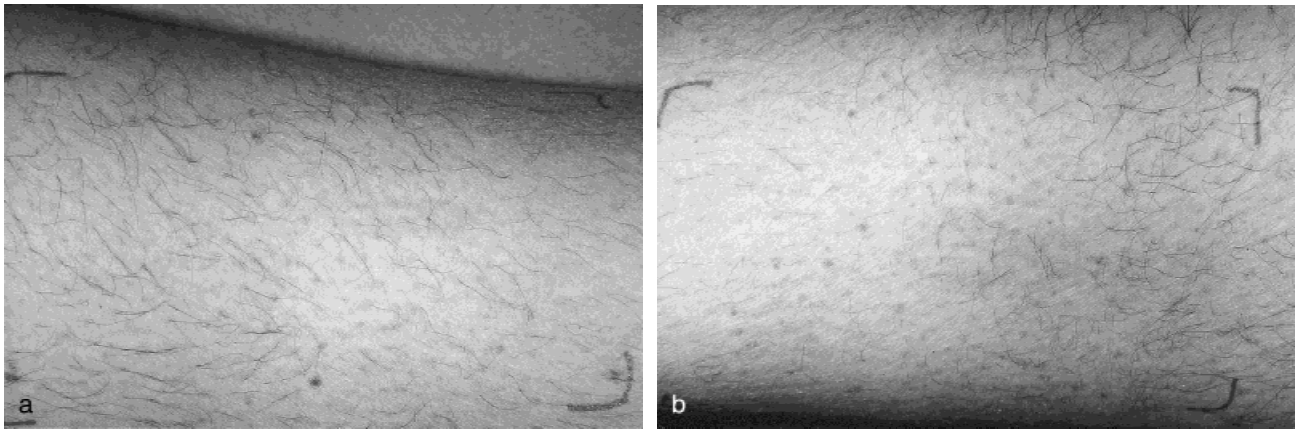

Fig. 3. **a:** Leg before treatment with 2-msec alexandrite laser. **b:** Leg before treatment with 10-msec alexandrite laser.

Fig. 4. **a:** Leg 6 months after third treatment with 2-msec alexandrite laser. **b:** Leg 6 months after third treatment with 10-msec alexandrite laser.

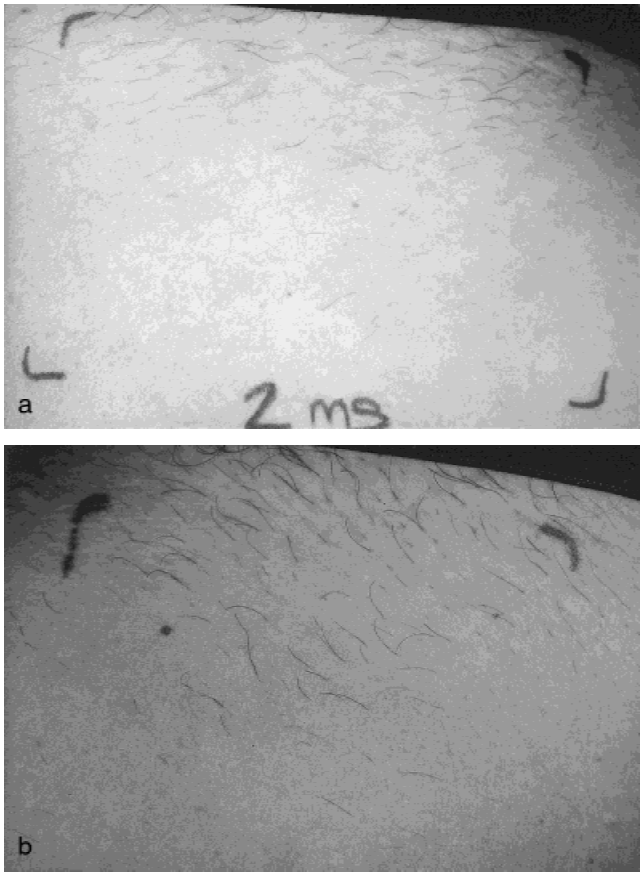

Fig. 5. **a:** Bikini before treatment with 2-msec alexandrite laser. **b:** Bikini before treatment with 10-msec alexandrite laser.

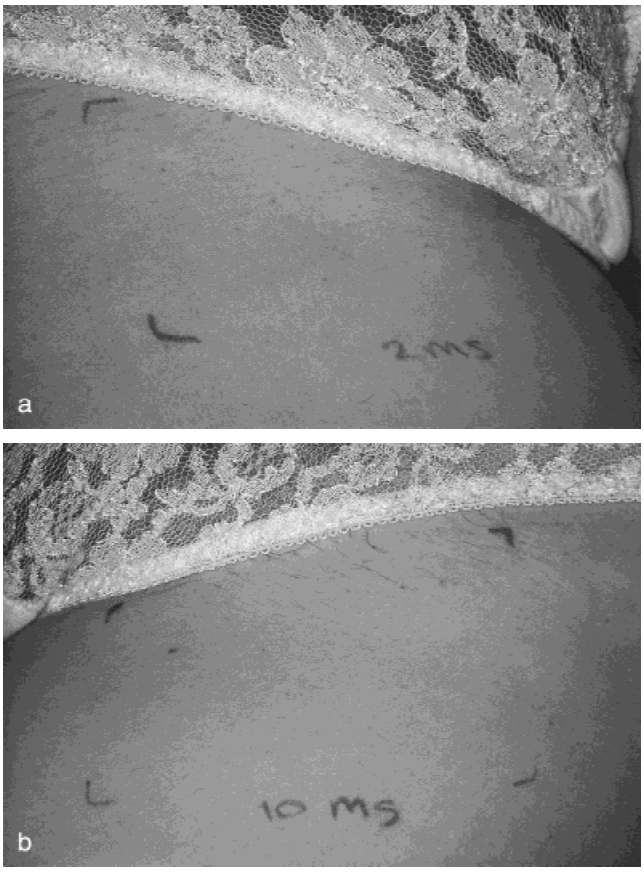

Fig. 6. **a:** Bikini 6 months after third treatment with 2-msec alexandrite laser. **b:** Bikini 6 months after third treatment with 10-msec alexandrite laser.

ter treatment and resolved within 24–48 hours. No cutaneous pigmentary changes or scarring was noted 6 months after the final treatment.

DISCUSSION

There has been a recent surge of interest in laser- and light source-based technologies for hair removal [4,11–17]. Q-switched Neodymium: Ytrium-Aluminum-Garnet lasers (1,064 nm), when used with or without carbon adjuvant, effectively produce short-term hair removal [11,12]. Photodynamic therapy, using topical aminolevulinic acid (ALA), has also been shown to effectively remove hair [18]. Ruby (694 nm) and alexandrite (755 nm) laser effects rely predominantly on laser absorption of endogenous hair follicle pigment. Recently, permanent hair loss has been noted in dark-haired individuals treated with a high-fluence, normal-mode ruby laser [15]. The alexandrite laser wavelength is also well-absorbed by melanin, and its longer wavelength allows for deeper penetration into the skin [19]. A 2-msec alexandrite laser has been shown to be efficacious in removing unwanted hair [17]. Another study noted no difference between a 5-msec, 10-msec, and 20-msec alexandrite laser after one laser hair removal session [20]. Our study is unique, in that it is the first published report to compare two pulse durations after multiple treatments. Our results showed a greater degree of improvement than that seen in the aforementioned study [20]. This may be due to more treatment sessions or the higher delivered fluences in our study. We initially expected that the 10-msec alexandrite laser would be more effective because of the greater confinement of thermal damage to the follicle. The purported benefit of this longer pulse duration may be equaled, though, by the greater peak power seen with a 2-msec laser system. Although our study showed an overall reduction of hair counts, there was no significant difference between the different pulse durations. Despite this lack of clinical difference, the 2-msec

pulse duration laser may ultimately be the better alternative because of its faster speed (five pulses per second vs. three pulses per second). It must be recognized that the sample size in this study was small. Greater statistical differences may be noted in a larger sample size. It is also conceivable that an even longer pulsed laser system may be safer in darker skin phenotypes. Fitzpatrick skin phenotype IV was not evaluated in this study.

CONCLUSIONS

We have shown that the alexandrite laser effectively and safely removes dark terminal hairs. However, we were not able to demonstrate a difference between the short and long pulse durations. Larger studies are required to verify the data of this relatively small study. In addition, studies evaluating darker skin phenotypes are required to determine if varied pulse durations are safer in such a group.

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